This is a pre-copy-editing, author-produced PDF of an article accepted following peer review for publication in *Society and Animals*.

Approaching insect death: understandings and practices of the UK's edible insect farmers

Christopher Bear

School of Geography and Planning, Cardiff University, King Edward VII Avenue, Cardiff, CF10 3WA, UK
Email: bearck@cardiff.ac.uk
Phone: +44(0)29 2087 6181

Abstract
While insects are eaten by around two billion people globally, they are a relatively new addition to the UK's culinary landscape. A domestic production sector has begun to emerge to supply this new appetite for insects. Social scientists have been quick to explore consumer attitudes to 'edible insects' but insect farmers have thus far been largely ignored. This paper addresses this gap by drawing on interviews with the UK's current and recent edible insect farmers to explore their understandings of, and approaches to, insect death, something about which all participants expressed concern. The paper examines: 1) reasons for farmers' concerns around how they kill their insects, ranging from anxieties around insect pain to perceived consumer attitudes; and 2) farmers' ideas about what constitutes a 'good' death for insects, and how they incorporate this in their practices.

Keywords
Insects; Entomophagy; Insect farmers; Livestock killing; farmer-livestock relations; Edible insects

Acknowledgements
I am grateful to all the participants who gave up their time to be involved in this study. The research was made possible by a period of Study Leave, granted by the School of Geography and Planning, Cardiff University.

Introduction

Insects contribute to the diet of around two billion people globally and have particular culinary significance in parts of Asia, Africa and Latin America (Van Huis et al., 2013). A 2013 UNFAO report (ibid) promoted their uptake in other parts of the world (see Dunkel & Payne, 2016), arguing that they provide more sustainable and highly nutritious alternatives to other forms of livestock (e.g., cows, chickens and pigs) because of their low land and energy requirements. However, these developments, along with human-invertebrate relations more broadly, have to date been side-lined in human- animal studies.

In response, this paper aims to broaden human-animal studies' engagement with insects by reporting on a qualitative study of the understandings and practices of the UK's edible insect farmers. Insect farming, as with other forms of livestock production, brings relations of care and killing into intimate proximity. While such relations have been studied relatively extensively in other livestock sectors (e.g., Convery, Bailey, Mort, & Baxter, 2005; Wilkie, 2005), no research has examined how insect farmers approach or understand the killing of their "minilivestock" (DeFoliart, 1995). In response, this paper extends two specific areas of study.

First, a limited body of work has begun to explore human-insect relations. This has highlighted insects' "awkward" (Ginn, Beisel, & Barua, 2014) nature; Lorimer (2007, p.920), for instance, has drawn attention to their "radical alterity to humans in terms of size, ecology, physiology, aesthetics, and modes of social organization". Some authors (e.g., Beisel, Kelly, & Tousignant, 2013; Bingham, 2006) have suggested that this alterity can inspire fascination and lead to different forms of intimate relations, with others building on this to explore how humans attempt to find ways of caring for insects (e.g., Maderson & Wynne-Jones, 2016; Phillips, 2014). Such research contrasts provocatively to the tendency to view insects as pests or disease vectors (Shaw, Jones III, & Butterworth, 2013; Shaw, Robbins, & Jones III, 2010), or beyond "moral obligation" (Loo & Sellbach, 2013). However,

studies of empathetic or caring relations between humans and insects have tended to focus on the fostering of life rather than practices of killing.

Second, there is an increasingly extensive literature on edible insects. Social research has tended to focus on consumer attitudes to eating insects (Hartmann & Siegrist, 2017; House, 2016; Sogari, Menozzi, & Mora, 2017), sometimes framed by the broader notion of "edibility" (Sexton, 2018). In contrast, the people who breed, farm or kill insects have been ignored (though see Wilkie (2018) for further detail on farmers' experiences of participating in this emerging sector). Closer scrutiny of farming (and slaughter) practices can be rewarding. Beyond involving a different form of livestock animal, insect farming offers significant contrasts to other livestock sectors. Insect farmers, for instance, work in a "legislative grey zone" (De Goede, Erens, Kapsomenou, & Peters, 2013, p.238), outside of established networks of practice, and without formal guidance or codes of practice. The positioning of insects outside of animal welfare legislation in the UK essentially provides farmers with freedom to care (or otherwise) for their animals as they see fit; for Röcklinsberg, Gamborg, and Gjerris (2017, p.376), this offers an "opportunity to be pro-active and craft practices and policies that at the outset attend to ethical issues", rather than simply transposing established codes or reacting to (for instance) crises in consumer confidence. At present, however, there is little sense of what practices are being crafted by these farmers, and on what basis these are emerging. This paper begins to address these absences.

In what follows, I briefly introduce the empirical context of edible insect farming in the UK, along with the methodology. Subsequently, framed by a discussion of existing literature around farmer-livestock relations and questions regarding insect sentience, I examine: (1) reasons for farmers' concerns around how they kill their insects, ranging from anxieties around insect pain to perceived consumer attitudes; and (2) farmers' ideas about what constitutes a "good" death for insects, and how they incorporate this in their practices. I conclude by considering the implications for future

work around insects in human-animal studies, arguing that research should not proceed on the assumption that insects are "doubly other" (Loo & Sellbach, 2013, p.13) and instead can be enrolled in complex, considered relationships with humans.

Edible insect farming in the UK

While entomophagy retains a niche status in the UK, edible insects are increasingly obtainable, whether in supermarkets (Calnan, 2018) or restaurants (Pieminster, 2017; Wahaca, 2014) (Grant, 2015). However, insect-based products in the UK have often relied on imports, with the UK's first (though short-lived) fully-operational commercial edible cricket farm only opening in 2017. In this sense, the UK's edible insect farming sector has been slow to develop in comparison to those in North America and Western Europe (see Dunkel & Payne, 2016). At the time of writing, six farms producing insects for human consumption in the UK have a public profile (e.g., with a website or Twitter feed), though not all of these are yet trading. A further three farms are known to be in the process of establishing themselves. To contextualize this, Dossey et al's (2016, pp.136-139) survey of insect farming enterprises identified 17 in Europe, but only two were in the UK (neither reached commercial stage and have both subsequently gone out of business). The UK farms with an existing public profile operate on a relatively small scale, with the largest understood to produce around 15kg of crickets a week[1].

The sale of insects in the European Union (EU) is subject to the Novel Foods Directive. Beyond this, however, farmers have considerable flexibility around the approaches they adopt, particularly in comparison to other areas of livestock farming. Recent guidance from the Thailand National Bureau of Agricultural Commodity and Food Standards (2018) and Evira (Finnish Food Safety Authority) (2018) point to the way this may change as the sector grows. However, because of the

[1] One farm has the capacity to produce considerably more than this but it has not yet begun trading in the insect-as-food sector.

comparatively limited regulation, insect farming has been characterized as "trial and error" (van Huis & Tomberlin, 2017, p.435), a situation compounded by the lack of availability of formal guides to insect rearing at a commercial scale. National and regional industry bodies have been established (such as the UK's Woven Network), but networks of insect farming knowledge and expertise remain limited (see also Wilkie, 2018).

As a result of this combined lack of established protocol and regulation of production, insect farmers in the UK have considerably more scope to experiment with their approaches than their counterparts in other areas of livestock farming. While the potential for insect farmers to "craft" new approaches has been commented on elsewhere (Röcklinsberg et al., 2017), no empirical attention has yet been devoted to the subject, something that this paper begins to address through its focus on how farmers understand and approach the killing of insects.

Methodology

This paper reports on qualitative research with individuals either currently or recently involved in the farming of insects for human consumption in the UK. The study involved 13 semi-structured interviews, each lasting between one and four hours. 12 of these were with insect farmers, one of whom was interviewed twice[2]; the producer interviews were augmented by a further interview with a representative of the industry body Woven[3]. The farmer interviews, conducted between July 2017 and May 2018, encompass all the UK's insect-as-food farming enterprises that were in operation during the period of fieldwork, along with those that had operated but closed within the previous two years. Five deal(t) exclusively with crickets, four with mealworms and two with a combination of species. After following the standard institutional ethical approval process, participants were

[2] In this instance, a telephone interview was conducted, during which the farmer invited me to visit his farm, where a further on-site interview was conducted.
[3] During the course of the research, and following this initial interview, the author became a Director of the Woven Network.

recruited online (either by email or via their business Facebook page), and interviews were arranged around their availability. Four interviews were carried out on-site in cricket and/or mealworm farms, four in person in 'neutral' locations, such as cafes, and the remainder over the telephone or Skype. Interviews were audio recorded with participants' permission, transcribed fully and coded with NVivo 11. Pseudonyms are used throughout the paper to protect the identity of participants.

The use of the term 'farmer' throughout the paper covers a variety of scales of enterprise and levels of involvement. For instance, the majority of participants farmed part-time, around other jobs and commitments. Four participants had a background in entomology (ranging from modules within a bachelor's degree to PhD and postgraduate research) but the majority had no prior experience of rearing insects other than (for instance) keeping stick insects as a child. Wilkie (2018) provides further discussion of this nomenclature. Further, the definition of 'farm' is fluid and should not be taken to convey images of large-scale specialist production facilities. Two of the farms, for instance, are inside participants' houses, while another three are in large garden sheds. In contrast, two are relatively large-scale and situated in converted barns on farms; the other farms sit between these extremes. In most cases, the participants hoped to expand in the future, although some explicitly set out to develop small-scale businesses, challenging the prevalent agri-food model. Seven of the farmers interviewed were male and four were female.

Considerate killing? Encountering death on insect farms

An expanding literature has explored the complex relationships between farmers and their livestock animals. Livestock farmers, it argues, are in a seemingly paradoxical position, rearing – and potentially caring in some way – for animals that they intend to kill. Wilkie (2005) developed a typology of such relations, ranging from what she termed "detached detachment" to "attached attachment" (p. 218). In the former, for instance, animals would be treated as "pure commodities", while in the latter animals would be recognized as individuals and might be "decommodified".

Between these two extremes, “concerned detatchment” continues to “deindividualise” animals but would acknowledge their sentience. Others have built on her framework, with Bock and Van Huik (2007, pp.120-121) noting that even “’detached detachment’ does not preclude taking good care of the animals and avoidance of suffering… What seems to be lacking is the emotional aspect of empathy, the recognition of the animal’s individuality and the acknowledgement of its animal nature”. Studying large-scale beef production in the USA, Ellis (2014, p.93) develops the concept of “boundary labor” to “describe the way producers’ emotion management separates cattle physically and emotionally from products derived from their bodies.” Further work has shown ways in which individual animals come to be recognized by farmers, as “an embodiment of farming skill in terms of breeding and husbandry, but also as biographical markers through which farmers may narrate not only their own life, but also the progression and cumulative work of several generations” (Riley, 2011, p.25). Such embodiment might result from close encounters between farmers and their animals, something that Bock and Van Huik (2007, p.122) conclude is “at the foundation of good stockmanship”. However, Wilkie (2005, p.226) observes that the types of relationship that emerge can differ through contrasting “human-livestock career paths”, noting that:

> the nearer workers are to the breeding side of the process, the easier it is for them to acknowledge their affinity with, and fondness for, the animals they husband… Finishers tend to have less direct contact with their store and prime animals and are less emotionally involved with them.

Insect farmers find themselves in a similarly paradoxical position to those in other livestock farming sectors, rearing their creatures with the purpose of ultimate death. However, the existing literature has focused almost exclusively on avian and mammalian livestock, and animals that are covered by welfare legislation and codes. Insects, in contrast, have been portrayed as “doubly other – other than humans and other than the animals that we eat”; they are “Tiny, multitudinous, with little

recognizable emotion or individual consciousness, they do not easily register as objects of moral obligation or as agents of ethical change" (Loo & Sellbach, 2013, p.13). In practical terms, Gjerris, Gamborg, and Röcklinsberg (2015, p.349) also note that ethical issues tend to be "left out of the considerations" of insect production. It might be expected, on these bases, that farmers would express a level of emotional and ethical detachment from their "minilivestock," particularly in killing.

The sheer number of animals encountered on insect farms might be anticipated to heighten such ethical distance. As Buller (2013, p.158, citing Despret and Porcher, 2007) noted:

> In today's large, modern livestock farms, the individual animal is subsumed into a functional collective of normative material life. If animals, in general, are good to think with, then with respect to farm animals: "Numbers help us to stop thinking" (Despret and Porcher, 2007: 36).

While Buller was referring to farms that might have up to, for instance, 30,000 dairy cows, insect farms potentially involve millions of individual animals, each often only a few centimeters long. This combination of insects' apparently "doubly other" status with the scale at which they are farmed might lead to "detached detachment" in Wilkie's terms, with individual insects and their experiences becoming less visible and/or valued.

Further significant differences appear to exist between commercial insect farming and other commercial livestock sectors. In contrast to Wilkie's discussion of human-livestock career paths, for instance, the majority of the UK's edible insect farmers are with their insects throughout their lives, from birth to death, and generally responsible not only for the rearing of insects but also for their culling. As Geoff explained:

> most farming is seasonal. So, you know, you've got lambing times, then you've got silage time, then you've got sale time... With this, every day is a cull, at least every two days is a cull day… So everything is compressed.

Finally, while the focus of this paper is on the killing of insects for the production of human food, it should be noted that insect death is not only present through the "culls" referred to by Geoff. Two farmers, for instance, spoke of their discarding insects that "escaped" from their tanks:

> when some of the beetles fly I discard them. Because I'm thinking if they flew once they're going to give the idea to others that they can actually fly. (Bethany)

> all of a sudden the temperature just kept climbing and climbing, and that's when they started burrowing out, chewing their way out. We were losing thousands of insects a week. (Geoff)

The discarding in the first example was unceremonial, equivalent of swatting a fly. In the second instance, the numbers were so great that they were left to die through starvation, the majority of them brushed up during routine cleaning of the rearing shed. Other insects died inadvertently – for instance through illness or cannibalism. All the farmers attempted to minimize such inadvertent mortality, as much for practical and economic motives as for any intrinsic concern about insect life. Cannibalization, for instance, could imply too great a stocking density and would reduce the overall efficiency of the farm.

Encounters with, and decisions about, death are, then, an inescapable and ever-present aspect of farming insects-as-food in the UK. In the examples above, insect life appears dispensable. However, and despite apparently significant differences from many other forms of livestock farming, all

participants devoted considerable thought to their slaughter practices. Mirroring long-standing debates in philosophical and scientific literature, discussion in interviews around insect slaughter often reflected on sentience and insects' ability to experience pain – and, indeed, on the very nature of pain itself. Gjerris, Gamborg, and Röcklinsberg (2016, p.105) note that "there is probably a large majority opinion, which holds that some invertebrate groups, such as insects, are not capable of suffering," but the ongoing ambiguity was referred to by participants. For instance, Julia commented that "you just don't know how much pain insects feel". As a result, not all farmers found killing insects to be emotionally easy; Siobhan, for instance, found that "It was very hard the first time".

Some authors have recommended that insect death might be dealt with through adopting or transposing concepts of "animal welfare" drawn from other sectors of livestock farming (e.g., van Huis & Tomberlin, 2017). Others, however, have argued that such concepts require translation as they were not developed with animals such as insects in mind. The International Platform of Insects for Food and Feed (IPIFF) (2019, p.2)[4], for instance, noted that, in contrast to mammalian livestock, "some insect species thrive when bred in a densely populated environment", and that "the current lack of scientific evidence around invertebrate welfare makes it very difficult to develop science-based welfare rules for insect production." Such ambiguities were encountered by farmers. In one instance, a farmer requested advice from the UK's Food Standards Agency (FSA) on how to go about killing mealworms; its representative responded by discussing "how abattoirs are set up for cows and chickens [and] he kept saying … the welfare comes from the sentience of the animal, how much the animal feels pain" (Julia), something that did not especially help her in addressing her concerns. Mike, another mealworm farmer, had similarly thought about the possibility of applying codes of welfare from other livestock sectors but concluded that "it's not so transferable. You're working on a microcosm scale" and, as a result, "just tried to be as ethical as possible," despite uncertainty about what this might consist of.

[4] An organisation that represents the insects as food and feed sector in Europe

While the scale of animal might be small, the number of animals present on even the smallest farms is great. Following Buller (2013; see also Lundmark, Berg, Wahlberg, & Röcklinsberg, 2015), it might be expected that potential impacts on the individuals, particularly in relation to their potential to feel pain, might disappear from farmers' purview. Indeed, farmers commented that the insects they worked with "are all identical" (Siobhan) and "you can only look at them collectively" (Tony). Similarly, crickets and mealworms – other than the escapees referred to above – are generally killed en masse rather than individually, so discussions of slaughter practices often focused on the population level rather than the individual. Patricia, therefore, commented that the large number of animals being killed on an almost daily basis made their slaughter easier: "because [mealworms] grow in such dense numbers it doesn't quite seem so bad harvesting them because you know you've always got lots left."

In this section, I have shown that, despite claims about the side-lining of ethical issues from insect production, farmers working with insects – rather than merely thinking about them – find themselves forced into frequent decisions about insect death, whether directly related to food production or through more inadvertent circumstances. While the scale of farming, with tens of thousands of crickets even on the smallest farm, can serve to disguise individuals, this does not stop farmers from thinking about their animals and how best to work with them. Following Bingham (2006), it is perhaps the very alterity of insects that inspires farmers to devote thought to their experiences of death; they work with ambiguity and the unknown rather than implementing established knowledge-practices. Here, ethics are emergent and situated rather than pre-existing practice (Holloway, Bear, & Wilkinson, 2014). I take these ideas forward in the next section, looking in more detail at how farmers explore the quandary of how to enact a "good death" in the face of ambiguity about what this might consist of.

A good death in insect farming

As noted in the previous section, the killing of insects for food is not aimed at individual animals but at larger groupings. A number of approaches are available to farmers – namely through cooling and subsequent freezing, blanching, or shredding (when a whole body is not required for a subsequent product). Little research exists on how each approach impacts individual insects (Erens, van Es, Haverkort, Kapsomenou, & Luijben, 2012). However, farmers (along with existing literature on insect farming) referred to all the approaches as "humane" in some way.

The desire for a good, or "humane", death came both from a concern for the insects as well as a desire to produce insects that would be acceptable to a potential market. Referring to the latter, and following her inconclusive conversation with the FSA, Julia spoke of the need to act in the face of scientific and ethical ambiguity:

> When it came to the pain of an insect, I had nothing. So I sort of had to make it up, but kind of using your common sense as well that there must be some level that they feel pain and that even if they didn't, the consumer would want to know that they're being killed still with, whether we know it or not, with the fact that they might have pain in mind, you know.

Others, faced by ambiguity around sentience and pain, spoke of the need for caution in the way insects are treated, with Siobhan arguing that, regardless of the existence of evidence around insects' reception of pain, "we should have respect for anything living." While some farmers expressed similar concerns and a desire to do what was best for the insects, enacting such respect was difficult. For the remainder of this section, I will explore how farmers approached this, as well as examining their broader discussions around practices of killing insects.

Harvesting insects that are to be used for human food is not a sudden event; whether shredding, blanching or freezing is the chosen method of slaughter, farmers tend to subject crickets to a period of starvation first. As Geoff put it:

> we want that cricket when we kill it to be cricket and not cricket plus gut contents. To give you an example, if you take 10 kilos of crickets and starve them for two days, you'll get about 7.5 kilos of crickets back, and you'll find a very big pile of cricket manure, and a few dead ones.

Starvation is seen as a necessary step through which insects might become edible (cf Sexton, 2018); it does not intend to improve the lives of the insects but implementing it for the wrong length of time could worsen their lives. Indeed, farmers expressed no concerns about how starvation itself impacted the insects but paid considerable attention to the length of starvation period. As Dave noted, if the period is too great, his crickets "start eating each other"; not only does this result in lower productivity for the farm, it also defeats the purpose of emptying the guts of those that are to be sold as food:

> you can never have all the crickets' guts cleared all the time because they're in proximity to other crickets, which they will eat. So we've just struck on the balance of two to three days is a good way you can get 75% of the weight back. (Geoff)

Cannibalism is often viewed as a practical challenge, but farmers also spoke of their concerns around its welfare implications. Gregory, for instance, aimed "for zero cannibalism on an insect welfare basis… You don't want your animals starting eating each other," and Jim referred to cannibalism as a "problem". Gregory's concern was in part for the experiences of his insects, but it also extended to the sector's public image: "I don't think that's a good sell! It just doesn't look nice". As a result,

Gregory only starved his crickets for one day, attempting to achieve a balance between what he viewed as the public perception of welfare and the desire to produce a hygienic and appetizing product.

While farmers held contrasting views about the starvation period and its relationship to cannibalism, most ethical concerns were raised about the method of killing itself. All but one of the participants in this study employed freezing as their main approach (the exception being a farmer who sold live insects, leaving the choice of approach to death to customers). In discussing their choice of approach, three farmers (Gregory, Bethany, Dave) referred to it as the most "humane" approach. Freezing involves, as Bethany described it, "putting them in the fridge, so they go to sleep. You put them in the freezer and they die." The justification for this approach is that cooling the creatures slows their metabolism down, "which is what happens at night anyway" (Mike); in other words, it mimics a sensation that the animals would experience in a non-domesticated environment. Mike described the move from fridge to freezer as making the insects "go from one percent awake to naught percent awake. And then if you leave them in the freezer for a day then they don't wake up again".

In other instances, farmers talked about what the process of freezing would feel like for the insects, suggesting some level of empathy for the creatures they were dispatching. For some, freezing was perceived as a relatively non-intrusive method that was unlikely to provoke pain:

> but I just use the freezer method and tell myself that they go nicely to sleep and that's that. Like I say, in terms of research, are they suffering when they're being frozen? I wouldn't have thought being frozen stiff was especially nice, but I have no idea and it just seems to be a reasonable way to do it. (Gregory)

> put them in the freezer for a bit, so that they just chill out and then quietly are dispatched. And I think that's the nicest way of doing it. (Patricia)

However, virtual unanimity about the approach taken disguised some discomfort amongst farmers, who implied that, although feeling it was the most humane method available, they did not relish this part of their business. Gregory, for instance, stated that "I don't like putting them in the freezer, but it seems to be the most humane way of euthanizing them." Siobhan, because of her discomfort around the practice, extended the cooling period and, as she describes below, ensured that they remained in a broadly familiar environment throughout, so as to reduce any possibility of stress:

> …take them out of the hydroponic tent[5], and then generally just put the tubs…outside so they cooled a little bit more. And then they generally just would slow down, they'd just stop running around quite so much. And then take out the main cardboard, any kind of stuff that was inside it. And then put them into a smaller tub…with an egg box in it so it's the environment that they knew and were happy in. And then collect them up and put them in there, and then put that tub in the freezer.

This approach related to Siobhan's desire to show her crickets "respect", doing what she felt would be best for them regardless of the existence of scientific evidence. In the absence of a scientific basis for insect welfare (IPIFF, 2019), farmers instead followed their ethical instincts, along with an ongoing reading of the animals they worked with. It is not through the implementation of existing codes or scientific evidence but through long term intimate engagement that many farmers attempt to become "responsible practitioners" (cf Phillips, 2014, p.157).

[5] More frequently associated with soil-free horticulture, hydroponic tents can be useful for smaller-scale insect farming as they hold a level of insulation and also enable farmers to control lighting conditions.

However, Jim felt less comfortable with the cooling approach and preferred "knocking them out with anesthesia…using carbon dioxide to essentially put the crickets to sleep and *then* freeze them." This, he said, was "probably the only thing that I'm doing that is just…with insect welfare in mind". He argued that killing solely by freezing could be "stressful for the insect" because:

> the crickets will go out of their way to find somewhere warm, and they get quite distressed if they're cold. So if you're freezing insects and it takes a couple of hours, potentially, or if you've got a decent freezer it'll take a lot less time than that, but it's still quite stressful for them.

Two final participants, who also felt that freezing was a humane approach, expressed some concern about whether or not crickets were dead:

> I read somewhere that when you put crickets into a freezer after a short period and take them out they'll…come back, they'll start hopping around again… So the thing with freezing for me is that again we just don't know, there's never going to be a point that it's like right they're dead now. (Julia)

While Bethany spoke of similar uncertainties around the moment of death, this was of less concern to her than the extent to which crickets would be aware of anything that subsequently happened to them:

> I think it's important to kill them…by putting them in the fridge so they hibernate and then put them in the freezer. So that the moment you cook them they are for sure asleep. So whether they feel the pain or not at that point they will not be feeling it, just because of the way you've handled them. So in that respect it's quite humane I think.

This section has challenged some of the assumptions in existing literature around the positioning of insect death beyond either moral considerability or empathetic relations. The motives for farmers' consideration of their approach to death varied, taking in concerns around insects' experiences of pain and stress, potential consumer perception and a desire to show insects respect.

Conclusions

This paper has begun to explore how the UK's edible insect farmers approach the harvesting of their insects. In so doing, it contrasts with existing social research on entomophagy, which has been dominated by a focus on insects' so-called "yuck factor" (Belluco, Halloran, & Ricci, 2017, p.804) and the associated (un)willingness of potential consumers to eat them. There are important parallels between these two broad areas of research. Most notably, moving beyond the yuck factor, research has commented on consumers' perception of insects as occupying an ambiguous position in relation to animality, allowing their consumption by individuals identifying as vegan alongside meat-eaters (House, 2019). This paper has illustrated ways in which insect producers navigate this same ambiguity in approaching insect death – whether or how the mode of death matters, and how to respond to this in their farming practices.

Given the uncertainties around sentience, combined with the sheer number of animals in even the smallest of insect farms, it might reasonably be expected that insects would be treated as "pure commodities." However, the paper has shown that edible insect farming does not neatly fit Wilkie's (2005) typology of human-livestock interaction. Some of the farmers talked of their efforts to individualize their mini-livestock, embodied partly in their concerns around how insects might feel or experience different approaches to their killing, despite (for instance) Siobhan's comment that they are "all identical" to look at, and despite the relative transience of insect-farmer relations. Their individuality, in other words, retains an ambiguity.

The paper has begun to show some of the ways through which farmers "craft" (Röcklinsberg et al., 2017, p.376) their practices around such ambiguities, demonstrating that ethical issues, while perhaps not foregrounded, are far from "left out of the considerations of production" (Gjerris et al., 2015, p.349). Farmers' concerns for the ways they killed their insects did not always stem from a belief in insects' intrinsic worth, nor necessarily from a belief in insect sentience or ability to experience pain. Indeed, ethical issues were sometimes considered primarily because of fears about how consumers might perceive their farming practices. Centrally, however, all the farmers felt at some level that they needed to act in the face of scientific and ethical uncertainty. As Bear and Eden (2011, p.349) argued, research in human-animal studies has often viewed characteristics such as "the cold blood or scaly bodies of fish as alien or as a barrier to attempting to understand and, to an extent, empathize with them." As with the anglers in their study, it might be argued that bodily difference and the lack of certainty around sentience and pain here acted not as a barrier to ethical consideration but rather as an *invitation* or provocation to understand, empathize with, and attune to insects.

This finding has practical implications for the edible insect sector's future engagement with notions of welfare and ethics and points away from the tendency to transpose welfare codes from other livestock sectors. These are constrained by "the current lack of scientific evidence around invertebrate welfare" (IPIFF, 2019, p.2); as such, IPIFF's welfare principles might be viewed more as a provocation for future research, and as a positive message to consumers and retailers, than as a workable code of practice. In the absence of such codes, Röcklinsberg et al. (2017, p.372) called for "animal welfare scientists and entomologists" to be involved in the future "development of production systems". However, moving beyond that ostensibly already-expert community may open up new questions for the sector, whilst guiding its practices towards acceptability as well as transparency and scrutiny. Future research, therefore, would usefully explore how non-scientific

groups and individuals construct “good welfare” in relation to insect farming. This might involve further exploration of insect farmers’ understandings and practices – not just in relation to insect death but to all stages of production. How, for instance, do farmers make sense of insect needs and even desires when working with different species and at different scales? It might also involve going beyond those directly involved in production, for example to explore how actual or potential consumers understand the notion of “good welfare” in edible insect farming.

A broader implication of this research is that the “doubly other” (Loo & Sellbach, 2013) status of insects in their relations with humans should not be taken for granted. These relationships are situated and specific, varying not only between species (cf Kellert, 1993) but places and contexts of encounter. Future work would usefully explore further ways in which humans engage, think and work with (as well as against) insects in different contexts: in different insect farming sectors, such as pet food, for medicine, for livestock feed and for scientific experimentation; in gardening and horticulture; in recreational angling; or as pets, for instance. Through such work, human-animal studies might develop a more holistic and inclusive approach to understandings of animality.

References

Bear, C., & Eden, S. (2011). Thinking like a fish? Engaging with nonhuman difference through recreational angling. *Environment and Planning D, 29*(2), 336-352. doi:10.1068/d1810

Beisel, U., Kelly, A. H., & Tousignant, N. (2013). Knowing insects: hosts, vectors and companions of science. *Science as Culture, 22*(1), 1-15.

Belluco, S., Halloran, A., & Ricci, A. (2017). New protein sources and food legislation: the case of edible insects and EU law. *Food Security, 9*(4), 803-814.

Bingham, N. (2006). Bees, butterflies, and bacteria: biotechnology and the politics of nonhuman friendship. *Environment and Planning A, 38*(3), 483-498.

Bock, B., & Van Huik, M. (2007). Animal welfare: the attitudes and behaviour of European pig farmers. *British Food Journal, 109*(11), 931-944.

Buller, H. (2013). Individuation, the mass and farm animals. *Theory, Culture & Society, 30*(7-8), 155-175.

Calnan, M. (2018). Sainsbury's stocks edible crickets in supermarket first. *The Grocer*.

Convery, I., Bailey, C., Mort, M., & Baxter, J. (2005). Death in the wrong place? Emotional geographies of the UK 2001 foot and mouth disease epidemic. *Journal of Rural Studies, 21*(1), 99-109.

De Goede, D., Erens, J., Kapsomenou, E., & Peters, M. (2013). Large scale insect rearing and animal welfare. In H. Röcklinsberg & P. Sandin (Eds.), *The ethics of consumption* (pp. 236-242). Wageningen: Wageningen Academic Publishers.

DeFoliart, G. R. (1995). Edible insects as minilivestock. *Biodiversity & conservation, 4*(3), 306-321.

Dossey, A. T., Tatum, J. T., & McGill, W. L. (2016). Modern insect-based food industry: current status, insect processing technology, and recommendations moving forward. In A. T. Dossey, J. A. Morales-Ramos & M. G. Rojas (Eds.), *Insects as Sustainable Food Ingredients* (pp. 113-152). San Diego: Academic Press.

Dunkel, F. V., & Payne, C. (2016). Introduction to edible insects. In A. T. Dossey, J. A. Morales-Ramos & M. G. Rojas (Eds.), *Insects as Sustainable Food Ingredients* (pp. 1-27). San Diego: Academic Press.

Ellis, C. (2014). Boundary labor and the production of emotionless commodities: The case of beef production. *The Sociological Quarterly, 55*(1), 92-118.

Erens, J., Es van, S., Haverkort, F., Kapsomenou, E., & Luijben, A. (2012). *A bug's life: large-scale insect rearing in relation to animal welfare*. Wageningen: Wageningen University.

Evira (Finnish Food Safety Authority). (2018). *Insects as food: Evira Guide 10588/2/uk*. Helsinki: Evira.

Ginn, F., Beisel, U., & Barua, M. (2014). Flourishing with awkward creatures: togetherness, vulnerability, killing. *Environmental Humanities, 4*(1), 113-123.

Gjerris, M., Gamborg, C., & Röcklinsberg, H. (2015). Entomophagy–why should it bug you? The ethics of insect production for food and feed. In *Know your food: Food ethics and innovation* (pp. 423-432): Wageningen Academic Publishers.

Gjerris, M., Gamborg, C., & Röcklinsberg, H. (2016). Ethical aspects of insect production for food and feed. *Journal of Insects as Food and Feed, 2*(2), 101-110.

Grant, K. (2015, 23 October 2015). Grub Kitchen: welcome to Britain's first insect restaurant. *Independent.* Retrieved from https://www.independent.co.uk/life-style/food-and-drink/news/grub-kitchen-welcome-to-britains-first-insect-restaurant-a6706891.html

Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in Food Science & Technology, 61*, 11-25. doi:https://doi.org/10.1016/j.tifs.2016.12.006

Holloway, L., Bear, C., & Wilkinson, K. (2014). Robotic milking technologies and renegotiating situated ethical relationships on UK dairy farms. *Agriculture and Human Values, 31*(2), 185-199.

House, J. (2016). Consumer acceptance of insect-based foods in the Netherlands: Academic and commercial implications. *Appetite, 107*, 47-58. doi:http://doi.org/10.1016/j.appet.2016.07.023

House, J. (2019). Are insects animals? The ethical position of insects in Dutch vegetarian diets. In A. Linzey, & C. Linzey (Eds.), *Ethical Vegetarianism and Veganism* (pp. 201-212). London: Routledge.

International Platform of Insects for Food and Feed. (2019). *Ensuring high standards of animal welfare in insect production*. Brussels: IPIFF.

Kellert, S. R. (1993). Values and perceptions of invertebrates. *Conservation Biology, 7*(4), 845-855.

Loo, S., & Sellbach, U. (2013). Eating (with) insects: insect gastronomies and upside-down ethics. *Parallax, 19*(1), 12-28.

Lorimer, J. (2007). Nonhuman charisma. *Environment and Planning D, 25*(5), 911-932. doi:10.1068/d71j

Lundmark, F., Berg, C., Wahlberg, B., & Röcklinsberg, H. (2015). 'One animal is no animal'– consequences of measuring animal welfare at herd level. In D. Dumitras, I. Jitea, & S. Aerts

(Eds.), *Know your food: Food ethics and innovation* (pp. 254-271). Wageningen: Wageningen Academic Publishers.
Maderson, S., & Wynne-Jones, S. (2016). Beekeepers' knowledges and participation in pollinator conservation policy. *Journal of Rural Studies, 45*, 88-98.
Phillips, C. (2014). Following beekeeping: more-than-human practice in agrifood. *Journal of Rural Studies, 36*, 149-159.
Pieminster. (2017). Anyone for cricket? Retrieved from https://www.pieminister.co.uk/anyone-for-cricket/
Riley, M. (2011). 'Letting them go'–Agricultural retirement and human–livestock relations. *Geoforum, 42*(1), 16-27.
Röcklinsberg, H., Gamborg, C., & Gjerris, M. (2017). Ethical issues in insect production. In A. Van Huis & J. K. Tomberlin (Eds.), *Insects as food and feed: from production to consumption* (pp. 364-379). Wageningen: Wageningen Academic Publishers.
Sexton, A. E. (2018). Eating for the post-Anthropocene: Alternative proteins and the biopolitics of edibility. *Transactions of the Institute of British Geographers*, *43*(4), 586-600.
Shaw, I. G., Jones III, J. P., & Butterworth, M. K. (2013). The mosquito's umwelt, or one monster's standpoint ontology. *Geoforum, 48*, 260-267.
Shaw, I. G. R., Robbins, P. F., & Jones III, J. P. (2010). A bug's life and the spatial ontologies of mosquito management. *Annals of the Association of American Geographers, 100*(2), 373-392.
Sogari, G., Menozzi, D., & Mora, C. (2017). Exploring young foodies' knowledge and attitude regarding entomophagy: A qualitative study in Italy. *International Journal of Gastronomy and Food Science, 7*, 16-19. doi: 10.1016/j.ijgfs.2016.12.002
Thailand National Bureau of Agricultural Commodity and Food Standards. (2018). Good agricultural practices for cricket farming. Retrieved from http://www.bugsolutely.com/wp-content/uploads/2018/02/GAP-Guidelines-bugsolutely.pdf
van Huis, A., & Tomberlin, J. K. (2017). Future prospects of insects as food and feed. In A. Van Huis & J. K. Tomberlin (Eds.), *Insects as food and feed: from production to consumption* (pp. 431-445). Wageningen: Wageningen Academic Publishers.
Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G., & Vantomme, P. (2013). *Edible insects: future prospects for food and feed security*. Rome: UN Food and Agriculture Organisation.
Wahaca. (2014). Mexican grasshoppers hit the Southbank once more. Retrieved from https://www.wahaca.co.uk/2014/11/mexican-grasshoppers-hit-the-southbank-once-more/
Wilkie, R. (2005). Sentient commodities and productive paradoxes: the ambiguous nature of human-livestock relations in Northeast Scotland. *Journal of Rural Studies, 21*(2), 213-230.
Wilkie, R. M. (2018). 'Minilivestock' farming: Who is farming edible insects in Europe and North America? *Journal of Sociology, 54*(4), 520-537.